No 41 C #22

Dec. 6 1826

192 Pine St.

This is a very interesting essay
Every word handled — a few trifling
errors occur in the spelling —

A Dissertation

on

Absorption

Passed March 12 1827
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by

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Nov. 1826

No part of the science of phisiology presents greater perplexity and confusion than the doctrine of absorption. The student finds presented to him, 'a rude and indigested mass', which he must separate and arrange in proper order. The several theories on this subject also are so mixed with hypothesis, intricacy, and error, that they tend to bewilder, rather than enlighten the mind.

The following are the principal causes which have tended to produce this confusion.

1 The ambiguity of the terms used. Not only are the same terms used by different authors to express different ideas, but the same term is often used in a different sense, by the same author. Some divide the absorbent system into two divisions, the lymphatic, and lacteal, while others refuse to extend the term absorbent, to the lymphatics. The deposit of lymph, according to authors, is the first part of the process of the formation of organic matter. The ends of a broken bone, say they, pour out lymph, this is a convenient nidus for

vessels to form in; they shoot into it from every part, depositing gelatine, cartilage, and at length bone. Again the process of cicatrization is very similar, 'coagulable lymph' is poured out, into which the vessels of the neighbouring parts are extended, forming a new part and healing the lesion. Adhesions between the viscera are assisted by the 'effusion of lymph'. Abscesses are surrounded by a layer of 'coagulated lymph'. But lymph is also that matter which is taken up by the absorbents to be carried to the general circulation, being no longer of use to the system. The fibrine of the blood, according to authors is 'coagulable lymph', the crassimentum is composed partly of coagulated lymph, and the serum appears by some to be considered very nearly as pure lymph. Hence lymph appears to be both the matrix in which organization commences, and also the refuse of the system, fit only to be carried out by the secretions. The ambiguity here evidently arises from giving several different meanings to the same word lymph. The use of the term should be confined to that limpid transparent fluid found in the lymphatics

2 Hypothesis has taken the place of theory, and general laws are laid down which are not sufficiently authenticated by facts. Much of the confusion on the subject of lymph before mentioned depends without doubt on the ambiguity of the terms, yet hypothesis has also contributed its share by supposing that lymph formed the bond of union between parts which are lacerated, or fractured, and is the matrix or nidus in which new parts are formed.

Is it rational to suppose that the same fluid can be the refuse of the system fit only to be carried out by the secretions, and at the same time the matter from which highly organized and new parts are formed? If the motion of the lymph be from the circumference to the center as the situation of the lymphatic valves appear to demonstrate, no retrograde motion can take place, neither can these vessels pour out lymph at the extremities. Nor does it happen from the divided vessels, for the fluid which appears upon the surface of wounds does not appear immediately after the accident, but when the inflamation is in such a state as to be best adapted to the healing of the wound. But further the lymph differs from the serum of the blood and that gelatinous matter which appears on the surface of wounds. both in its chemical and mechanical properties. The lymph is a transparent limpid fluid, not coagulable by heat or acids. Serum is coagulable by both, and has some viscidity. This gelatine has considerable viscidity unlike the limpid fluid of the lymphatics

3 The opinions of great men who have investigated this subject are received by many as facts. Thus many relying upon the opinions of those who have written on this subject, consider it a fact capable of demonstration, that absorption is continually going on in the solids as well as the fluids, and that the lymphatics are the vessels by which this process is carried on. But as shall presently be shewn It is probable the first of these does not take place and then

are some very powerful arguments against the probability of the second. It is curious to observe how far the spirit of speculation has carried some great men. Richerand not only feels assured that the lymphatics perform the office of absorption, but describes the particular manner in which this action is performed. "The mouth "of a lymphatic when about to absorb, erects itself, draws towards "itself, and raises the surrounding membranous parts, and thus "forms a small tubercle similar to the puncta lacrymalia." (Richerand's Physiology C. II. S. 42.)

These then are the heads under which the causes which have tended to perplex and confuse our subject may be arranged; and lymph appears like the doctrine of sympathy to be a very convenient assistant to help the physiologist or pathologist out of any troublesome perplexity in which he may happen to be entangled.

It shall be the object of the present essay, after taking a brief view of the doctrine of absorption, to examine how much is theory supported by facts, and what part is merely hypothesis, shewing that absorption is continually taking place in the fluids, and rendering it extremely probable that absorption only takes place in the solids when there is a change in the organization, or in other words that in the healthy adult, when not under the operation of foreign agents, no absorption of the solids takes place.

Absorption may be defined that function by which bodies are taken into the circulation

The Ancients were acquainted with the existence of the lacteals, but without any idea of the important function they perform. They supposed that they were arteries; the lacteals of a kid are described as such by Erasistratus, and Galen was of the same opinion. The thoracic duct was described by Eustachius as the vena sine pari.

In 1822 Asellius discovered upon opening the abdomen of a living dog, a set of vessels on the surface of the intestines, and mesentery, carrying a milky fluid and successfully uniting to form larger trunks; these vessels he called lacteals from the appearance of the fluid they contained, and to the fluid itself he gave the name of chyle. Encouraged by this success anatomists and physiologists made many experiments on living animals

In 1651 Pecquet upon opening the heart of a living dog, discovered a white fluid mixing with the blood in the right auricle of this organ, suspecting it to be chyle he continued his experiments to try and discover a communication between the lacteals and heart, he at length discovered the course of the chyle thro' the thoracic duct. Till then it had been supposed that the lacteals terminated in the liver.

This being the great desideratum which had long been wanted in order to explain the manner in which the aliment was conveyed into the blood, the discovery of the lacteal system gave

a new direction to the researches of physiologists, and may be considered next to the circulation of the blood the most important improvements of modern times

In 1651 and 1652 the lymphatics and the remaining parts of the absorbent system were discovered by Rudbeck Jolyffe and Bertholine. In 1654 Dr. Glisson advanced the opinion that the lymphatics were the organs of absorption, that by these vessels the fluids and solids were taken up to be carried into the circulation. He was naturally led to this conclusion, by observing that the thoracic duct was formed by the common union of the lacteals and lymphatics. The office of the lacteals was then acknowledged to be absorption, and finding that this function existed in other parts of the body beside the intestines while no particular set of vessels had as yet been appropriated to this use, he very naturally concluded that these were the vessels by which this function was performed.

This doctrine did not however receive much credit most anatomists adopting the idea that they were continuations from the veins. (For a more full account of this see Cheseldens anatomy.)

But the greatest opponent of this doctrine was Haller. Perceiving that the same necessity existed for absorption in birds and fishes as in men and quadrupeds and as yet no traces of a lymphatic system were found in these animals, he concluded that these could not be the organs of absorption.

Since the time of Haller, much light has been thrown upon the subject by the researches of Hunter and Monro, so that the doctrine of lymphatic absorption has gradually gained ground till it was pretty generally received, and has been acknowledged almost universally.

Of late the doctrine of venous absorption has been revived from the circumstance that most indefatigable search has not succeeded in discovering lymphatics in the brain when it is well known that absorption takes place. Here then, it is said, absorption is performed by the veins and why may they not perform that function in other parts.

The organs of absorption are the absorbent vessels, the absorbent glands, and the receptaculum chyli with its continuation the thoracic duct.

There are three kinds of vessels which have been supposed to perform this office, the lacteals, the lymphatics, and the veins.

The lacteals are vessels arising from the surface of the intestines and uniting successively to form larger trunks, till all empty themselves into the receptaculum chyli.

The lymphatics are vessels arising from almost all parts of the body, which unite to form larger trunks, and mostly empty into the thoracic duct. The carry a limpid transparent fluid which from its resemblance to water is called lymph.

The veins are said by some to perform the office of absorption and

whether we consider the lymphatics as absorbents or not, there is little doubt, but that in many cases it is performed by the veins.

The absorbent glands are knobs, or small oval bodies, into which the vessels pass, and from which others go out. Their particular use is not known. The lymphatic glands are mostly seated in the cellular substance, and the lacteal glands in the mesentery.

The receptaculum chyli is a small sac on the lumbar vertebra into which both lacteals and lymphatics ~~taps~~ terminate. It is continued upwards into the thoracic duct, a membranous canal which runs along the spine and terminates in the left subclavian vein.

The modern doctrine of absorption is this, That all these vessels continually take up fluids from all the cavities cells and surfaces of the body and also that all the solids, the muscles, nerves, tendons, and even the very bones are continually changing, the old matter being absorbed and new matter being deposited in its stead, so as to prevent in some degree the decay of the system, and to keep up a continual renovation by the addition of new particles.

That absorption takes place and is continually going on in the system cannot be doubted, that fluids are continually absorbed and that solids are occasionally taken into the circulation, must appear obvious to all who have examined this subject.

There is in all the cavities a viscid fluid whose office is to lubricate the parts contained within the cavity, preventing friction and abrasion. Now as this fluid readily putrifies and is found

in considerable quantities there is great reason to suppose that an exhalation and absorption are continually taking place. Sometimes these fluids accumulate to an enormous extent forming the disease of dropsy, and as these masses of fluid are again in some instances removed by the application of remedies, the only rational conception we can form of the manner in which they acts is by help of the absorbents. Again it is probable a change is taking place in these masses of fluid, even in dropsies, to prevent putrefaction

In the joints also, a fluid is poured out, which is necessary to lubricate the joint, but which if left to accumulate would impede its motion, and unless continually changed, would putrefy.

Again fluids which are effused under the cuticle, as serum or blood; and pus in the cellular substance are often removed without any external opening; the only manner in which we can account for their removal is by absorption.

From these facts it is probable an absorption of fluids is continually taking place, for without this supposition we find it impossible to account for these phenomena.

Not only does absorption take place in the fluids, but the solids are also absorbed on some occasions, tho' not continually as some have supposed.

The tumours which are the consequence of inflamation are frequently removed in a gradual manner, and the parts regain their former appearance. By pressure upon any part the solids beneath are

removed, and this is one means of reducing unnatural swellings. Again in some diseases the whole body becomes diminished, both in bulk and weight, the fluids and all the solids are diminished in quantity. Now we can conceive of no manner in which these phenomena take place, without supposing that by the action of the absorbing vessels, these solids are taken up and thrown into the circulation.

But the greatest proof that absorption takes place in the solids is derived from the circumstances attending the growth of the body. We find all the solids maintaining nearly the same shape in the adult as in the infant. The processes foramina and other parts of the bone preserve the same relative situation to each other, and remain in nearly the same proportions. Now we cannot conceive how this could happen unless we suppose the absorption of some of the old particles, and the deposition of some new ones, not precisely in the same situation and of the same number, but in such a manner that the bone may preserve the same shape, and its different parts the same relative position, while it increases in magnitude. This growth of bone could not take place from the superficial addition of any layer of bony matter without absorption, as the processes would not by these means be further separated in the adult than in the infant. Neither can we conceive of any interstitial deposition of matter by which the process of growth can be carried on in the bones. We also find the foramina of bones increase in size ~~and~~ at the same time and in the same proportions that

the other parts of the bone enlarge. We find the foramen which gives passage to the medullary artery larger in the adult than the whole bone was in the foetal state, so that in many bones it is sufficiently large to have contained the foetal bone. The medullary canal also regularly increases with the other parts of the bone. The increase of these cavities it is evident must take place by absorption and the deposition of matter, in any manner alone, could never cause a canal to increase in its dimensions.

From these facts it must appear evident that absorption of the fluids is continually going on, that absorption takes place in the solids during the action of foreign bodies on the system, in disease, and during the growth of the body. In these cases it is necessary in order that the body may be accomodated to those changes which are taking place. But when no change takes place in the organization of the system as in the healthy adult, when not under the action of foreign causes, we have no reason to believe in the absorption of the constituent particles

1 There is no necessity for such a change. For aught that we know the particles of matter which now compose my body are as fit for the purposes of life and for the due maintainance of all the functions as any new particles which can be added to its composition. If the particles of matter remain the same and retain the same properties in all their combinations and then is nothing to lead us to believe the contrary, the only change which can take place in any body where the particles remain the same must result from a change of organization

But the advocates of the doctrine of assimilation assert that no change ordinarily takes place in the organization, but that the old particles are absorbed and new particles deposited in the same organic form; but if the properties of these particles remain the same where is the necessity for this change. We observe an economy in all the works of nature. She employs no more agents than are necessary for the performance of any function and, as far as we can judge it is performed in the best possible manner, but as we can conceive of no necessity for the continual change of the solids, is it rational to suppose that any such change takes place? It is necessary that those fluids be changed which lubricate the joints or moisten the inner surface of the cavities, preventing friction, and lesion of the viscera, in order that putrefaction be prevented, and that they may continually preserve their proper consistence; but the same necessity does not exist in the solids, there is not that tendency to putrify, and it is probable that the putrefaction of the solids is owing to the fluids they contain. We see that those parts which contain the most fluids are most liable to putrefy, and when a certain portion is abstracted as in dried meats, there is no longer any tendency to decomposition. But as the circulation is continually going in parts even the most minute and as these fluids are continually undergoing a change sufficient to prevent putrefaction in them, there can be little doubt but that this change effectually prevents any tendency to a septic state of the solids.

Again the lubricating fluids unless changed lose in a short all

the powers for which they were intended. They change their consistance so that in a short time all lubricating power is lost. To prevent this is probably one reason why these fluids in the body are continually changing. But no change is necessary in the solids in order that they may perform their functions. The only change which takes place in the composition of the animal solids that we know of, is by putrefaction, but as this is probably prevented, as has been shewn, by the motion of the fluids, and as the change of the component particles of the body can in no manner contribute to the better performance of its functions, we can conceive of no necessity of any change on this account.

2 The gradual decay of the body as we advance in years and the effects of age in the body as well as the mind, render it probable that no change takes place in the component particles of our solids In taking a survey of human life we see a threefold state of childhood, manhood, and old age; in the first of which the corporeal powers are continually improving, in the second they apparently remain stationary, and in the third they are gradually declining till they cease in death.

In the infant the muscular fibres are lax and almost incapable of action. The bones are soft and yielding, supplied in a great measure by cartilage, and wanting the phosphate of lime which gives them firmness and strength in the adult. During the whole period of ~~infancy~~ childhood the body increases in magnitude and weight

by the continual addition of new matter. All the faculties and powers gradually increase in energy and skill. The bones become solid and increase in magnitude. Strength vigour and precision of action are acquired by the muscles; while the sensibility and and irritability of the nervous system are increased. At this period of life the functions of assimilation nutrition and absorption exist in the highest degree, to increase the size of the body, and model it to its true figure.

In manhood, man exists in the greatest perfection. The bones are then firm, the muscles are vigorous and capable of action, while the corporeal powers appear to remain stationary, except so far as a change is effected by increased dexterity and the habitual exercise of the muscles, and on the other hand the change produced by accident or disease.

In old age, all the faculties and powers are declining. The numerous accidents to which mankind are liable produce a continual effect upon the organization, and altho' in manhood and youth we may appear to have escaped the effects of an injury yet still some consequences remain, and by the accumulated effects of numerous accidents a manifest change is produced on our constitution, which must sooner or later bring on ~~death~~ old age. In this state of life, all the muscles become rigid and lose that elasticity and energy of action which characterized them in youth, the bones contain more phosphate of lime, and hence become brittle, calcareous deposits are formed in different parts of the body, as in the arteries veins the

cartileges of the joints, the heart, and even in the brain itself. The whole body contains less fluid, and more solid matter, producing the slow and stiffened motions of age.

This decay of the system leads us to believe that absorption does not take place in its fullest extent as is commonly asserted by Physiologists. For if the old particles were continually taken up and new matter deposited in their stead, would not a continual renovation take place and would not decay be effectually prevented? And as we see that altho' the body remains apparently stationary a short time after youth, yet decay soon commences, and as the body soon declines, is it not rational to suppose that the component particles remain as long as the same organization continues? The body worn down by the continual action of external agents by disease and the other vicissitudes to which life is subject decays like other matter its powers become enfeebled and the functions of life cease.

3 From the manner in which the bones are formed, there is great reason to suppose that a continual absorption is not continually taking place in them. Bones increase in magnitude while all their parts preserve their relative position, and peculiar proportions. The process by which this is effected, is not by a continual change of the component particles of bone, neither by an interstitial deposition of bony matter ~~in the~~ but by the deposition of earthy matter on the surface of the bone by which its breadth is increased; and also by the deposition of matter on its extremities increasing its length. The absorbents remove at the same time the internal surface to

increase the medullary cavity and also those surfaces of the processes which look toward the centre of the bone, while the deposition of earthy matter on the opposite surfaces of these processes, makes them apparently to recede from the centre and preserve the same relative situation

The facts which tend to prove this position are the following

1st If a young animal be fed for some time on madder and then for some time be kept from this diet upon killing the animal and making a section of its bones we find a layer of bone tinged with madder surrounded by another portion of its natural colour shewing that bones are only absorbed when this process is necessary to the economy of life.

2d We find that madder is deposited in bone to a distance corresponding with the length of the bone at the time when this diet was given to the animal: while at each extremity of this there is a deposit of bone not tinged.

3d The discoloration is greatest upon the surface just at those points when the extremities of the bone were at the time the madder was given For the heads of the bone being equally tinged with the other parts, and being larger in circumference, would project farther than they into the deposit on the surface

(Specimens of bone shewing these facts may be seen in the anatomical museum of the University of Pennsylvania.)

4th Some experiments of Mr Hunter also tend to prove this opinion.

He bored two holes in the bone of a living animal accurately measuring their distance, he placed a shot in each hole and closed the wound; the animal when an adult was killed and the two points were found at the same distance precisely as before. This is a proof that bones do not increase by interstitial deposition but by the deposition of matter on each extremity.

4 There is no proof of this continual change in the solids. All the arguments which have been adduced only shew that absorption takes place during a change in the organization i. e. when foreign bodies act upon the system in disease and during the growth of the body. The experiments with madder which are brought forward by John Bell do not affect the subject and are not correctly stated. By feeding animals madder, says Mr. Bell, their bones are soon tinged of a deep red, and by discontinuing this for a short time, they again become white. Now admitting this to be the correct statement, it would only shew that madder was deposited, and that madder was absorbed, and certainly no inference can be drawn from this that the earthy matter of the bones was at the same time changed, for as Mr. Bell observes the madder is deposited in the interstices of the bone. But these are not the facts the redness is not removed except in those cases, when the medullary cavity is larger in the adult than the whole bone was when the madder was given or then the madder is removed with the bony matter, to enlarge the internal cavity.

From these facts, I think, we may rationally conclude, that no change takes place in the component particles while no other happens in our bodies.

To this doctrine some seeming objections present themselves, but when examined closely the objection is found to be only apparent and not of any force.

1 – As the blood is continually receiving new matter, and we find the constant supply of food to be necessary for our existence; hence it may appear very probable that a constant addition is made to our solids or there would be no necessity for this constant supply of new matter.

But when we view the phenomena of life, we find secretion constantly going on in all our organs, and in every part of our body; we find the secreted fluids necessary for very important purposes, and a proper regulation of the secreting organs necessary for the due maintenance of health. Hence, can we doubt, that one very important purpose of this constant addition to our circulation, is to supply matter to the secretions whose presence appears so necessary to our existence.

2 – Again we find the blood circulating thro' the whole system in every organ, and thro' every tissue, what necessity is there for this continual circulation, if no change takes place in our bodies?

To this it may be answered, that we find the existence of circulation as necessary for sensation and motion, as the continuity of the nervous fibre. When a ligature is placed upon the femoral artery, sensation is as completely destroyed below, as when the nerves of the thigh are divided. During syncope, when the heart ceases to act, the loss of motion is as great as when the functions of the brain are disturbed; shewing that the stimulus of circulation is necessary to the due performance of

the functions of the nervous system. This then is one very important office of the circulation, another is the due performance of secretion as mentioned before. So we find many very important offices to be performed by the circulation in the economy of life independant of Assimilation.

3 It has been supposed that animal heat depends on assimilation; that the change which is supposed to take place in the passage of fluids to a solid state causes an evolution of heat. According to this theory a continued assimilation is necessary to account for the animal heat.

But the truth of this theory depends upon the truth of the other theory of ~~absorption~~ assimilation, and its authors appear to have forgotten that a body in passing from a solid to a fluid state will absorb as much heat as it gives out in passing from a fluid to a solid; and hence dissimilation is as great a source of cold, as assimilation is of heat. The agency of the circulation in the production of animal heat appears to be simply this; It is found that venous blood has less capacity for caloric than arterial and to be of the same temperature must contain less absolute caloric. Hence in the passage of arterial to venous blood a certain quantity of latent caloric becomes manifest in consequence of the change of capacity. The only use then of the blood in the production of animal heat appears to be that of a convenient vehicle, to transport it to different parts; and as the difference between the specific heat of arterial and venous blood is very small, even in this view its agency can be very little. But the experiments of Mr. Brodie appear to demonstrate that the animal

heat is nearly or altogether independant of circulation and respiration; and hence this objection to the of absorption is altogether overthrown.

4 But it may be asked how can we account for the change of the blood from arterial to venous, without the apistance of the doctine of asimilation.

Upon examining the blood as it appears in these two states, we find that the principal difference consists simply in this, the arterial is more florid, and has a greater capacity for caloric. We find the colour of the blood is changed, with a very trifling change in its composition. If a quantity of venous blood be exposed under a jar of oxigen it assumes the florid colour almost immediately, and accurate experiments discover no diminution of the quantity of oxigen, and the difference between the specific heat of these diffeaent kinds of blood as mentioned before is very small.

But in the adult state some change is continually taking place in the organization from the action of foreign bodies and from disease; then at the same time a change takes place in the component particles of that part but still there is no necessity for a continual change in other parts: so that altho we allow that at every successive moment of our lives a change may take place in some part, yet in the adult only so far as caused by disease or foreign agents.

Hence, as no rational objection can be produced against this doctine, and from the facts which have been adduced